CLAIMS

1. A method of kinetic spray coating a substrate comprising the steps of:

a) providing particles of a powder;

b) injecting the particles into a gas/powder exchange chamber and entraining the particles into a flow of a main gas in the gas/powder exchange chamber, the main gas at a temperature insufficient to heat the particles to a temperature above a melting temperature of the particles;

c) directing the particles entrained in the main gas in the gas/powder exchange chamber into a powder/gas conditioning chamber having a length along a longitudinal axis of equal to or greater than 20 millimeters; and

d) directing the particles entrained in the flow of gas from the conditioning chamber into a converging diverging supersonic nozzle, thereby accelerating the particles to a velocity sufficient to result in adherence of the particles on a substrate positioned opposite the nozzle.

2. The method as recited in claim 1, wherein step a) comprises providing as the particles at least one of an alloy, a metal, a ceramic, a polymer, a metal coated ceramic, a semiconductor, or mixtures thereof.

3. The method as recited in claim 1, wherein step a) comprises providing particles having an average nominal diameter of from about 1 microns to 250 microns.

4. The method as recited in claim 1, wherein step b) comprises injecting the particles under a pressure that is from about 5 to 300 pounds per square inch above a pressure of the main gas.

5. The method as recited in claim 1, wherein the main gas is at a temperature of from about 200 to 1000 degrees Celsius

6. The method as recited in claim 1, wherein step b) comprises injecting the particles parallel to a longitudinal axis of the gas/powder exchange chamber.

7. The method as recited in claim 1, wherein step b) comprises injecting the particles at one of an oblique angle relative to a longitudinal axis of the gas/powder exchange chamber or at a tangential angle relative to the gas/powder exchange chamber.

8. The method as recited in claim 1, wherein step c) comprises directing the entrained particles into a powder/gas conditioning chamber having a longitudinal axis of from about 20 millimeters to about 1000 millimeters.

9. The method as recited in claim 1, wherein step d) comprises accelerating the particles to a velocity of from about 200 to about 1500 meters per second.

10. The method as recited in claim 1, wherein step d) comprises providing a substrate comprising at least one of a metal, an alloy, a plastic, a polymer, a ceramic, a wood, a semiconductor or a mixture thereof.

11. A kinetic spray nozzle system comprising:

a gas/powder exchange chamber, a powder/gas conditioning chamber, and a converging diverging supersonic nozzle;

said conditioning chamber having a length along a longitudinal axis equal to or greater than 20 millimeters; and

said conditioning chamber positioned between said exchange chamber and said supersonic nozzle with said conditioning chamber in communication with said exchange chamber and said supersonic nozzle.

12. The kinetic spray nozzle system as recited in claim 11, wherein said conditioning chamber has preferably a circular cross-sectional shape.

13. The kinetic spray nozzle system as recited in claim 11, wherein said length along said longitudinal axis is from about 20 millimeters to about 1000 millimeters.

14. The kinetic spray nozzle system as recited in claim 11, further comprising a particle injector tube in communication with said exchange chamber.

15. The kinetic spray nozzle system as recited in claim 14, wherein said injector tube has a longitudinal axis that is parallel to a longitudinal axis of said gas/powder exchange chamber.

16. The kinetic spray nozzle system as recited in claim 14, wherein said injector tube has a longitudinal axis that is one of at an angle of 90 degrees with respect to a longitudinal axis of said gas/powder exchange chamber or at a tangential angle relative to the gas/powder exchange chamber.

17. The kinetic spray nozzle system as recited in claim 14, wherein said injector tube has an internal diameter of from about 0.3 to about 3.0 millimeters.

18. The kinetic spray nozzle system as recited in claim 11, wherein said converging diverging supersonic nozzle has a throat with a diameter of from about 1.0 to about 5.0 millimeters.

19. The kinetic spray nozzle system as recited in claim 11, wherein said conditioning chamber releasably engages said gas/powder exchange chamber and said converging diverging supersonic nozzle

20. The kinetic spray nozzle system as recited in claim 19 wherein said conditioning chamber includes a plurality of threaded portions, one of which releasably engages a corresponding threaded portion on said gas/powder exchange chamber and another of which releasably engages a corresponding threaded portion on said converging diverging supersonic nozzle.